PIGSKIN PROCESSING WITH SHORT FLOATS*

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Abstract

A process for tanning pigskin has been developed at the Eastern Regional Research Center using short floats, recycled washes, lowered quantities of chemicals, and short processing time. The process appears to overcome two problems associated with handling pigskin, the need for large quantities of water and the amount of grease that must be handled.

Sampling and analytical procedures developed in cattlehide processing research were applied to evaluate this process. Pigskins were processed to the blue in a pilot-scale tannery and acceptable finished leather was made from it both at the Eastern Regional Research Center and by commercial pigskin tanners.

The process used is outlined along with analytical results and subjective evaluations of the leather. The composition of the effluent projected from a full-scale pigskin tannery using this process is compared with the effluent from a cattlehide tannery.

Introduction

Several years ago when the cattle herds in this country were in the process of being rebuilt, there was severe competition for U.S. cattlehides because of both decreased supply and heavy demand for raw material by foreign tanners. As cattlehide prices rose in response to this situation, a demand was created for a substitute raw material for making leather. It appeared that pigskins might fill that demand. In this country at the time, about 90 million pigs were slaughtered, only 2½ million of which were being skinned. The bulk of these skins was shipped overseas, mainly to eastern European countries including Yugoslavia, Hungary, and Czechoslovakia. Based on literature abstracts, much of the world's published research on pigskins was also being carried out overseas; very little was being done in this country.

There are a number of recognized difficulties with the manufacturing and marketing of pigskin leather. In this paper the difficulties in converting the raw

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skin to the blue will be addressed. The most persistent problems associated with pigskin processing are the reported need for large quantities of water and the difficulty in removing natural fat from the skins. Subsequent treatment of grease in the effluent has not been considered in this work, but it may be a problem as other investigators have shown (1-3).

Information from a search of the literature was used to develop a basic method for processing pigskins into blue that is suitable for making full grain leather. This method largely alleviates the problems previously cited. The development of this method also resulted in a shorter process time than used in most published methods (4-6).

Experimental

Rawstock

Three lots of pigskins from two different sources were used in the experiments. The first and second lots were sow skins, the third butcher-hogskins.

Process

Six experiments were run, five (A through E) with sow skins and one (F) with butcher-hog skins. All experiments were carried out in a Challenge Cook* stainless steel pilot-scale hide processor. The amount of rawstock processed was 240 lb each for experiments A through D, 400 lb for experiment E, and 295 lb for experiment F.

Soak

Float	100 percent
Temperature	80°F

Run 5 min, rest 5 min for a total of 30 min

Drain float

Repeat soak

In run B, the second soak was drained to a holding tank to be used as the first soak in run C. The skins were refleshed on a Baker-Layton fleshing machine before continuing with the next step.

Scour

Float	100 percent
Temperature	90°F
Soda ash	2 percent
Triton X 114	0.3 percent

Run continuously for 60 min

Drain float

*Reference to brand or firm name does not constitute endorsement by the U.S. Department of Agriculture over others of a similar nature not mentioned.

Unhair

Float	100 percent
Temperature	85°F
Na_2S	2 percent (A,B,C)
	1.75 percent (D,E,F)
NaHS	1.5 percent (A,B,C)
	1 percent (D,E,F)
Run continuously for 20 min	
Lime	2 percent
Run continuously for total 4 to 5 hr	
Drain float	

Caution should be observed when running on a larger scale, or in a drum, to avoid the excessive heat build-up that would most likely occur with continuous running.

Relime

Float	200 percent
Temperature	85°F
Lime	4 percent
Triton X 114	0.3 percent
Run 20 min/hr for 12 hr	
Drain float	
Batch wash (3x)	
Float	150 percent
Temperature	90°F
Run continuously for 10 min	
Drain floats	

The second and third washes from experiment B were drained to holding tanks and were subsequently used in the first and second washes in experiment C. In run E, only 100 percent floats were used to prevent the capacity of the processor from being exceeded.

Delime and Bate

Float	150 percent
Temperature	100°F
NH_4Cl	4 percent
1500 EU Bate	1 percent
Run continuously for 1 hr	
Drain float	
Batch wash (2x)	
Float	125 percent
Temperature	90°F
Run continuously for 10 min	
Drain float	

In run E, only 100 percent floats were used.

PICKLE

Float	100 percent
Temperature	80°F
NaCl	5 percent
H_2SO_4	1.25 percent

Run continuously for 1 hr
pH 2.5-2.7
Use float in tan

TAN

Float (pickle)	100 percent
Temperature	80°F
$NaCHO_2$	1 percent
Tanolin R	10 percent (A,B,C)
	8 percent (D,E,F)

Run continuously for 3 hr
Neutralize (two feeds)

$NaHCO_3$	1 percent
H_2O	2 percent

Run continuously for 1 hr
Final pH 4.0-4.3

The Tanolin-R was dissolved with heating in 4 gal of water. When the solution cooled to 100°F, it was added to the processor. Chromesaver A-30 was used in experiments D and E.

SAMPLING

The skins and effluent were sampled as described in a previous paper (7). In experiments A through D both the skins and effluent were sampled, in experiment E only the skins were sampled, specifically for grease analysis. No samples were taken in experiment F; the stock used in this experiment was butcher-hog-skins, and this run was made so the resulting leather could be evaluated by a commercial pigskin tanner.

ANALYSES

The chemical analyses carried out on skins and effluent are described in a previous paper (7).

Results and Discussion

Over the past three years at ERRC a number of industrial processes for bringing cattlehides through to the blue have been thoroughly analyzed. Methods of sampling both hides and effluents for the various chemical analyses were developed during these investigations (7). Computer programs were also developed to help in evaluating the resulting data. We have developed a process to produce pigskin leather and have evaluated it using these same techniques.

The process described was designed to conserve water. Use of a hide processor facilitated this objective as previous work has suggested (8). Approximately 1.85 gal of water per pound of skin processed were needed in the initial process. In experiment C, recycling of wash waters reduced the water consumption to 1.4 gal per pound of skin processed. This flow ratio is less than that set for cattlehide through to the blue by the EPA (9), but is not lower than that obtained for cattlehides in our equipment. However, this water usage figure does not include plant cleanup. Only 1.7 gal/lb of skin was used on the 400-lb lot because the load limit of the processor (800 lb, including float) was reached. In addition to lowered water consumption, processing time was generally lowered. In particular, the liming period was shortened to just 12 hr.

It should be emphasized that the resulting leathers would be suitable for shoe uppers. Some modifications would have to be made in this basic formula to obtain the softness necessary for garment leather. For example, a longer liming and use of HCl in the pickle would give a softer product.

The blue stock from each pack was sent back to the original suppliers and finished to their specifications. The crust stock (finished products) was of first-run quality in the opinion of both suppliers.

Analyses of Skins

The natural grease in pigskin initially caused difficulty in sampling. Moreover, the first lot of skins received were poorly prefleshed and brined. During processing the grease content of the skins decreased reproducibility in the initial stages of process. After the first experiments the technique for sampling improved and, subsequently, so did the precision of the analyses.

Figure 1 illustrates the trend in moisture content of the skins as they went through the process. In run A, the analyses were made on only one sample, but in the remaining runs composite samples were analyzed. Moisture pickup and loss is similar to that found in cattlehide processing.

Figure 2 illustrates the removal of chloride from the skins as they are processed. This trend is also similar to that observed in cattlehide processing. At the end of the bate step, the chloride content is as low as 0.3 percent on a moisture-free basis, even though NH_4Cl is used as the deliming agent. The chloride is found in the effluent, probably as calcium chloride. Recycling the presoak did not increase the chloride content of skins.

Figure 3 illustrates that fat removal takes place at each stage of process. It follows that the TKN content, expressed on a moisture-free, ash-free basis, increases as the skins are freed of fat (Figure 4). This was one of the more difficult analyses due to sampling problems. It was felt that a computer-fitted curve

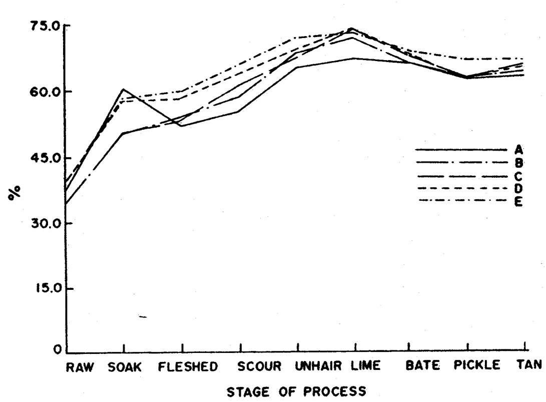


FIGURE 1. — Moisture

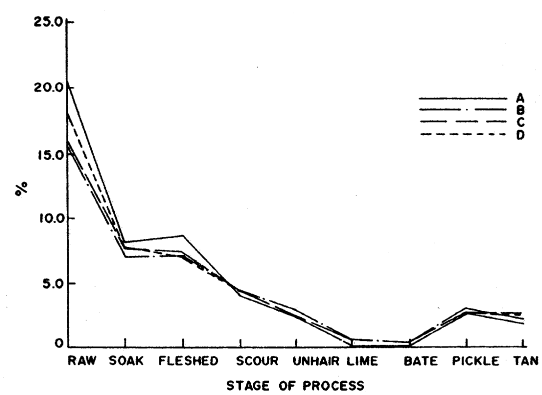


FIGURE 2. — Chloride (moisture-free basis)

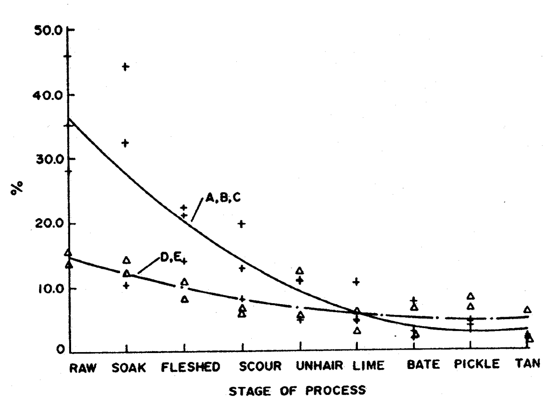


FIGURE 3. — Fat (moisture-, ash-free basis)

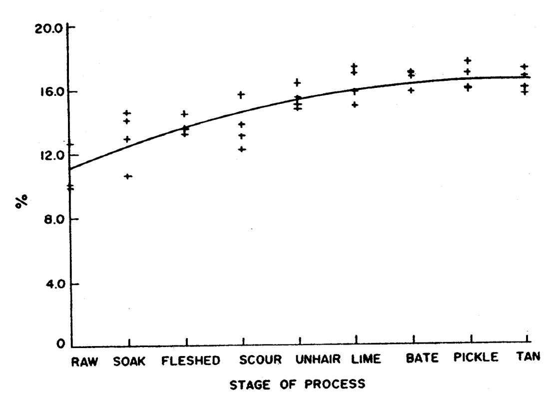


FIGURE 4. — Total Kjeldahl nitrogen (moisture-, ash-free basis)

through the results from four of the experiments would illustrate the effect that grease removal would have on the TKN content of the skin. The curves in Figure 3 illustrate the results of poor prefleshing and brining in runs A to C. Having been well prefleshed, the skins used in runs D and E were cleaner, and contained less fat.

The Cr_2O_3 content of the blue stock treated with 10 percent Tanolin R ranged from 4.0 to 4.59. When Chromesaver was used along with 8 percent Tanolin R the Cr_2O_3 content ranged from 3.34 to 3.70%. The resulting products in all cases had a shrink temperature exceeding a 3-min boil.

Effluent Analyses

Figures 5 to 10 illustrate the effect of each processing step on effluent composition and help visualize the reproducibility of the various runs. All of the loadings are calculated on the basis of pounds per 1000 lb of rawstock processed.

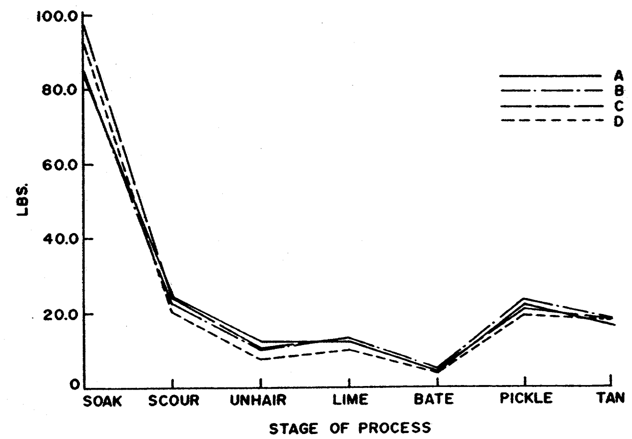
The chloride removed from the hide during each stage of processing is graphed in Figure 5. The reproducibility of the process for each of the four runs analyzed can be clearly seen. The remaining figures all show an additional measurement of materials which are removed from the hide during processing and which end up in the effluent. Total, dissolved, and fixed solids have similar patterns of removal.

Run C was a recycling experiment using the washes from run B as the treatment solutions for each step. Even in this case, no significant variations were observed, although overall water usage was reduced. Continued recycling might eventually lead to some solids buildup, although even that would level off.

The only anomaly observed was in measuring the total Kjeldahl nitrogen (TKN), shown in Figure 9. In the case of run D, the TKN removed after bating was higher than the others. In this particular case the stock was drummed in the lime for 30 min on the hour instead of the 20 min per hour described under Methods. Whether this additional mechanical action could cause this increase should be pursued in further work. That the increase in TKN was not due to ammonia can be seen in Figure 10.

In Table I, composite values obtained from five analyses of the floats and washes from industrial cattlehide processing (7) are compared to corresponding values obtained by averaging data on the effluents from four runs of pigskin processing. The values are expressed as pounds per 1000 lb of rawstock processed, and the ranges in values are also shown. Higher total solids and dissolved solids in pigskin effluents reflect the higher amounts of salt used in brining and the higher natural grease content of the rawstock. The ammonia and nitrogen contents are not far out of line, but the high COD in pigskins again reflects grease content and possibly the use of surfactant at various stages of processing.

Water usage and basically all effluent component levels based on the weight of rawstock are higher in the effluents from pigskin processing than cattlehide processing. However, the potential yield of grain leather from equivalent weights of



FIGURES 5-10 – Materials generated at each processing stage (calculations based on 1000 lb of skin processed)

FIGURE 5. – Chloride.

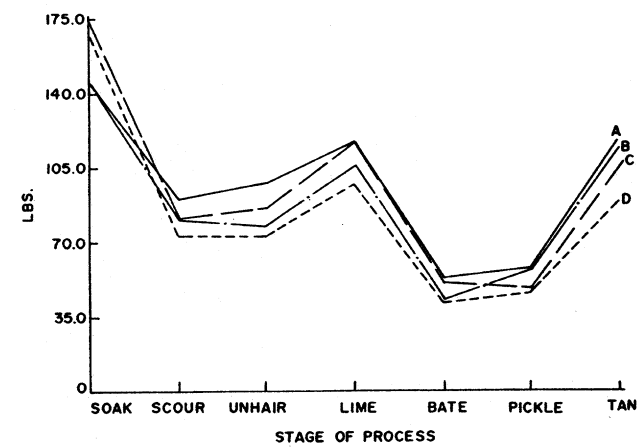


FIGURE 6. – Total solids.

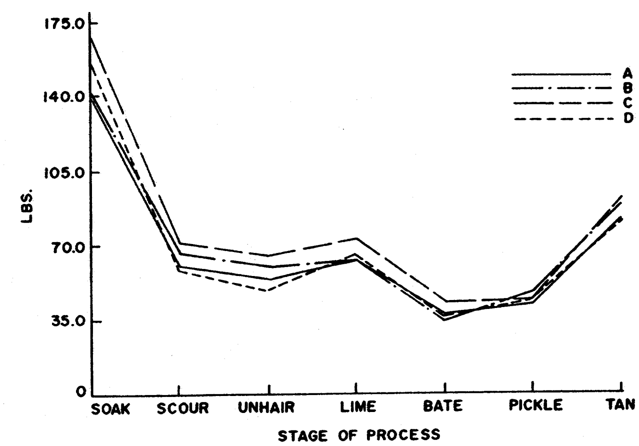


FIGURE 7. – Dissolved solids.

FIGURES 5-10
(cont.)
Materials generated at each processing stage (calculations based on 1000 lb of skin processed)

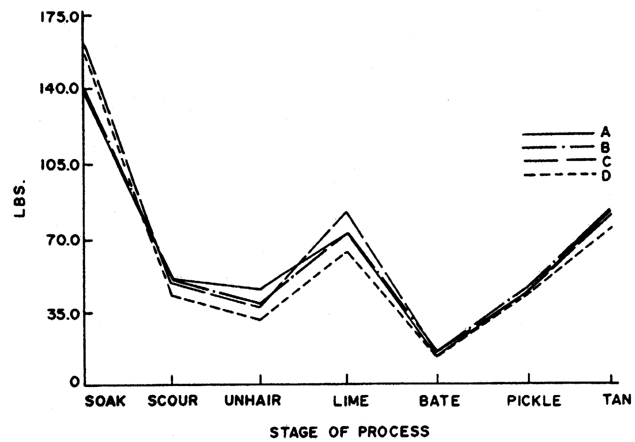


FIGURE 8. – Total fixed solids

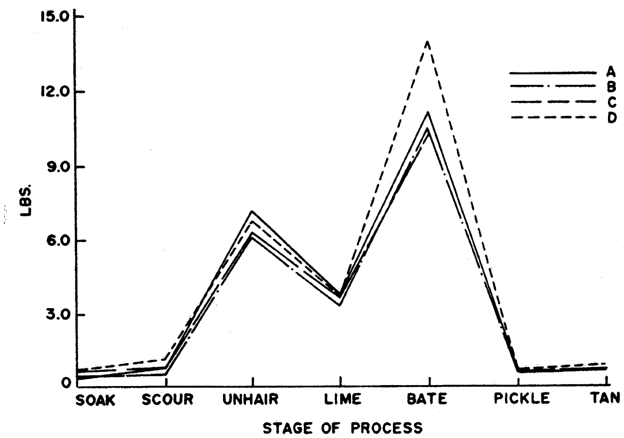


FIGURE 9. – Total Kjeldahl nitrogen

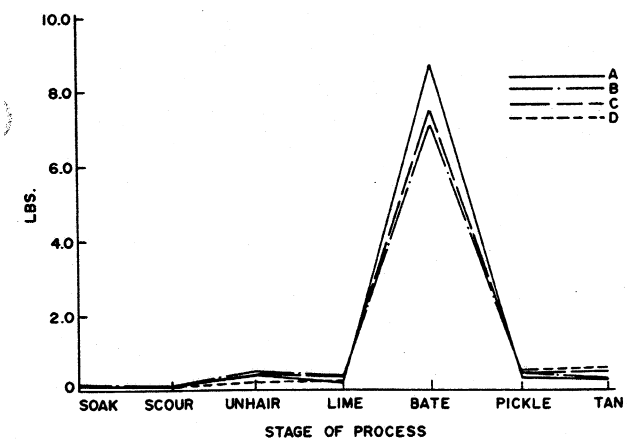


FIGURE 10. – Ammonia

TABLE I
Comparison of Wastewater Loadings

Parameter	Average loading lb/1000 lb rawstock	
	Pigskin	Cattlehide
Flow[a]	1740 ± 198	1488 ± 350
Total solids	638 ± 48	438 ± 95
Dissolved solids	505 ± 38	386 ± 104
Ammonia	9 ± 1.1	7 ± 2.5
Oil and grease	50 ± 19	11 ± 6
Chloride	180 ± 9	131 ± 28
TKN	24 ± 3	16 ± 6
COD	327 ± 39	102 ± 25

[a] In gal/1000 lb rawstock.

raw stock is greater from pigskins. While conventional processing of 60 lb of green steerhide yields approximately 45 sq ft of grain leather, an equivalent weight of raw pigskin will yield close to 60 sq ft. Even considering the value of a cattlehide split, effluent treatment costs based on the total square feet of leather produced will be comparable, and may well be less, for pigskins than for cattlehides.

In summary, a low-float, rapid process was developed to produce a leather from pigskin products that was judged to be acceptable for making shoe uppers. Recycle of washes was successfully employed to help conserve water with no apparent harm to the process. The final product was found to be low in natural fat and minimal problems were encountered in dealing with the oil and grease in the original pigskins.

Acknowledgments

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Discussion

MR. LEO DEVARENNE (Wolverine World Wide, Inc., Discussion Leader): Dave, I want to thank you and your staff for this fine paper and to express my concurrence with all of the comments on the value of ERRC to the American leather industry that Bob Lollar made when Steve Feairheller was up here. It is also encouraging to see that someone else feels that pigskin is a very important raw material of the future. It makes some of us feel that the decisions we made twenty years ago weren't that bad. I have some questions, but since I am prejudiced on the subject, I will first call for questions from the floor.

MR. JACK HUSSELBY (British Leather Manufacturers Research Association): I would like to ask from what area of the skin the samples were taken for analysis? I ask this because of the problem around the root of the tail.

DR. DAVID BAILEY: Most of the samples were taken in the backbone area, but down toward the rear. They were taken consistently from there, so it would be consistent sampling. I cannot give you any idea of the variation.

ADEL HANNA (E. F. Gallun and Sons Corp.): I have two questions, Dave. What vessel did you use in this process? Was the washing batch or continuous?

DR. BAILEY: It was a hide processor, and the washing was batch.

MR. HANNA: Do you have any data on the fat content of the blue stock?

DR. BAILEY: Yes we do. I do not recall the numbers; they were in the final slide.

MR. HANNA: Do you have any data on the fat content of the leather?

DR. BAILEY: No, we did not analyze the final leather for fat.

MR. JOHN WORMSER (Ellithorp Tanning Co.): Dave, you mentioned adding 1 percent of a certain chemical before chrome tanning. Would you give us the name of the chemical? Was it formate?

DR. BAILEY: Yes, it was.

MR. DEVARENNE: Dave, one of the questions that I had was touched upon by Adel. Do you have a preference as to a range of fat content on a moisture-free basis in the blue that is the most desirable?

DR. BAILEY: No. We approached this study on the basis of producing a product and evaluating it. We have not done enough work to come up with a range of different fat contents, so we can not say whether there is one that is better.

MR. DEVARENNE: Since fat is one of the most pressing problems with pigskin, have you done any experiments where you degreased at a later stage than what you reported on today?

DR. BAILEY: No, we did not at ERRC. We attempted to get the grease out early, rather than wait. The skins sent out to be finished may have had an additional degreasing step in the blue.

MR. DEVARENNE: One other question concerns the selection of sow skins versus butcher hogs if you were making full grain leather?

DR. BAILEY: Sometimes decisions on initial raw stock are made on less than a scientific basis. In this case, we had the sow skins available at the time we were to do the work. It was only recently that we were able to obtain a supply of top hog raw skins that had been brine cured.

MR. DEVARENNE: If there are no further questions, I want to thank you again, Dave, for this very interesting paper.